concentration of the analyte being a function of the composition of the particular gas mixture in which it is contained, the response characteristic of the sensor material will preferably remain constant or vary to only a small extent over an extended period of time at a constant temperature. For example, the response characteristic, if it varies, will vary by no more than about twenty percent, preferably no more than about ten percent, more preferably no more than about five percent, and most preferably no more than about one percent over a period of at least about 1 minute, or preferably a period of hours such as at least about 1 hour, preferably at least about 10 hours, more preferably at least about 100 hours, and most preferably at least about 1000 hours. One of the advantages of the sensor materials described above is that they are characterized by this kind of stability of response.

In applications in which the gas mixture is above about 400°C, the temperature of the sensor materials and the array may be determined substantially only, and preferably is determined solely, by the temperature of the gas mixture in which the analyste gas(es) are contained. This is typically a variable temperature. When higher-temperature gases are being anaylzyed, it may be desirable to provide a heater with the array to bring the sensor materials quickly to a minimum temperature. Once the analysis has begun, however, the heater (if used) is typically switched off, and no method is provided to maintain the sensor materials at a preselected temperature. The temperature of the sensor materials thus rises or falls as does the temperature of the surrounding environment. The temperature of the surrounding environment, and thus the sensors and the array, is determined by (or results from) substantially only the temperature of the gas mixture to which the array is exposed.

In applications in which the gas mixture is below about 400°C, it may be preferred to maintain the sensor materials and the array at a preselected temperature of about 400°C or above. This preselected temperature may be substantially constant, or preferably is constant. The preselected temperature may also be about 500°C or above, about 600°C or above, or about 700°C or above. This may be conveniently done with a heater incorporated with the array, in a manner as known in the art. The temperature of the gas mixture may also be below about 300°C, below about 200°C, or below about 100°C.

A change of temperature in the array may be indicated by a change in the quantified value of the electrical response characteristic, resistance for example, of a sensor material. At a constant partial pressure in the mixture of a gas of interest, the electrical response characteristic of a sensor material may vary with a change in temperature of the array, and thus the material. This change in the value of the electrical response characteristic may be measured for the purpose of determining or measuring the extent of change of, and thus a value for, temperature. It is preferred that this measurement of temperature be made independently of the determination of the electrical responses of the chemo/electro-active materials. This can be done by connecting the temperature measuring device in parallel circuitry with the sensor materials, rather than in series. A thermocouple or a pyrometer is useful for the purpose of determining the temperature of the array. Particularly if the termperature determining device is a thermistor, typically a material that is not responsive to an analyte gas, the thermistor is preferably made from a different material than the material from which any of the gas sensors is made. Regardless of the method by which temperature or change in temperature is determined, a temperature value or a quantified change

in temperature is a desirable input, preferably in digitized form, from which an analysis of an analyte gas in a mixture of gases may be performed.

Unlike various prior-art technologies, in the method and apparatus of this invention, there is no need to separate the component gases of the mixture for purposes of performing an analysis, such as by a membrane or electrolytic cell. There is also no need when performing an analysis by means of this invention to employ a reference gas, to bring the response or analytical results back to a base line value. With the exception of preliminary testing to determine a standardized response value to be assigned to the exposure of each individual sensor material to each individual analyte gas. The sensor materials are exposed only to the mixture that contains an analyte gas component. The sensor materials are not exposed to any other gas to obtain response values for comparison to those obtained from the analyte. The analysis of the component gas(es) of interest is therefore performed only from the electrical responses obtained upon exposure of the chemo/electro-active materials to the mixture containing the analyte. No information about an anyalte gas is inferred by exposure of the sensor materials to any gas other than the analyte itself as contained within the mixture.

This invention therefore provides a method and apparatus for directly sensing the presence and/or concentration of one or more gases in an multi-component gas system, comprising an array of at least two chemo/electro-active materials chosen to detect the gases in a multi-component gas stream. The array, gas of interest, gas stream, and chemo/electro-active materials are as described above. The multi-component gas system can be at essentially any temperature that is not so low or so high that the sensor materials are degraded or the sensor apparatus otherwise malfunctions. In one embodiment, the gas system may be